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Identification of facial expression on basis of discrete wavelet transforms

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Abstract: **In recent years, facial recognition technology, a kind of image recognition, is a relatively new biometric technology which appeared with the rapid progresses of image processing technology, computer technology and pattern recognition technology. Wavelet transform has several obvious advantages, especially the discrete wavelet transform (DWT). In this paper, facial recognition, which includes preprocessing, feature extraction and output of recognition results, is accomplished by MATLAB based on such knowledge. By several experiences, it is a practical design that accomplishing image recognition based on wavelet transform.**

Key words: **Wavelet Analysis, Image Recognition, Feature Extraction, Feature Matching**

I. INTRODUCTION

Image recognition is the classical problem in image processing to determine whether or not the image data contains some specific object, feature, or activity, and facial recognition is an important branch of image recognition[1,2]. Among the different biometric techniques, facial recognition may not be the most reliable and efficient. However, one key advantage is that it does not require aid from the test subject. Usually feature extraction is an important step in the facial recognition[3,4]. In facial recognition, feature extraction is a special form of dimensionality reduction. If the features extracted are carefully chosen it is expected that the features set will extract the relevant information from the input data in order to perform the desired task using this reduced representation instead of the full size input. The wavelet transform could capture both frequency and local information[5,6]. It is widely used in image recognition. This paper studies the facial recognition based on wavelet analysis and finish the facial recognition.

II. ADVANTAGES OF WAVELET TRANSFORM

In this paper, we use wavelet transform to realize feature extraction, because wavelet transform, compared with Discrete Cosine Transform (DCT) or Discrete Fourier Transform (DFT), are localized in both time and frequency, which is more efficient and effective for facial recognition. Wavelet transform has obvious advantages in 2D images processing.

- First, wavelet transform is a multi-resolution.
- Second, wavelet transform calculate faster than other transforms.
- Third, wavelet transform extends the recognition's range of target images. And after wavelet transform, data does not increase, and maybe reduce the computation.
- Forth, wavelet transform can realize denoise processing for images, so it could improve the accuracy of the facial recognition.

III. METHODS

The specific algorithm steps of facial recognition based on wavelet transform are:

- First, select the wavelet function, and determine the kernels of wavelet transform.
- Second, applied the wavelet transform in target areas in the training samples by the selected wavelet function, and extract the facial feature information of training samples.
- Third, using the same method to process the unrecognized images, obtain the facial feature information of unrecognized images.
- Fourth, define the threshold of difference between the feature information of unrecognized images and feature information of training samples.
- Fifth, if it's possible, compare different details in horizontal, vertical and diagonal between feature information of unrecognized images and feature information of training samples.
- Sixth, calculate the results of different pixels between unrecognized images' faces and training samples' faces.
- Seventh, output the final recognition result.

IV. PROCESS OF FACIAL RECOGNITION

Facial recognition is an important branch of image recognition, the specific process shown in Figure 1.

Firstly, we did some preprocessing operations, in order to guarantee the consistency of face position, and on certain extent to overcome the background, hairs, neck and other redundant information. Then, extract the facial features, and compare the obtained features between unrecognized faces and training samples. Finally, determine the result according to the level of similarity.

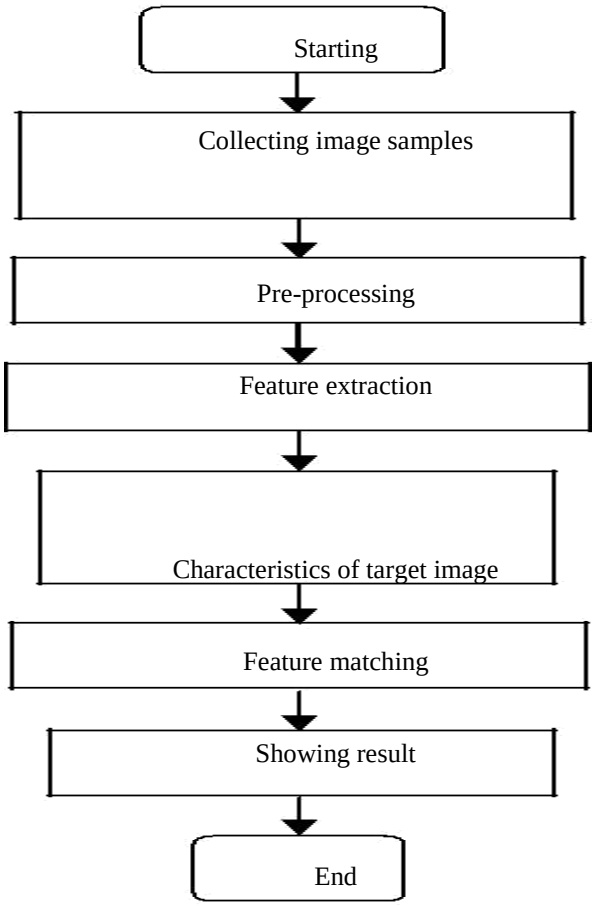

Figure 1 Process of face recognition

A. Preprocessing of images

In order to ensure that all people faces are similar in the image's size, position and tilt invariance, we need to remove the hair, neck, shoulder and image background which is useless. Before the feature extraction, facial images must be geometrically normalized.

First, read out the training samples, shown in Figure 2, and then read out the unrecognized images, shown in Figure 3.

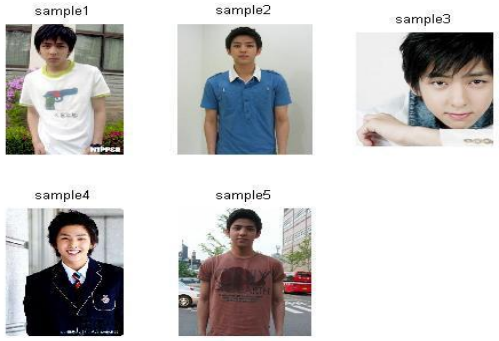

Figure 2 training samples

Figure 3 unrecognized images

Then, rotate the images to make sure the connection of eyes on the horizontal. This guarantees the consistency of face position. The rotated training samples' are shown in Figure 4 and unrecognized images are shown in Figure 5.

Figure 4 rotated training samples

Figure 5 rotated unrecognized images

Thirdly, cut the image to reduce the redundant parts of the images. Due to the difference sizes of images, the cut faces' size are different as well. The cut training samples' faces are shown in Figure 6, and the cut unrecognized images' faces are shown in Figure 7.

Figure 6 cut training samples' faces

Figure 7 cut unrecognized images' faces

Finally, adjust the sizes of all images to get the standard images with the same size.

Training samples' faces after pretreatment are shown in Figure 8 and unrecognized faces after pretreatment are shown in Figure 9.

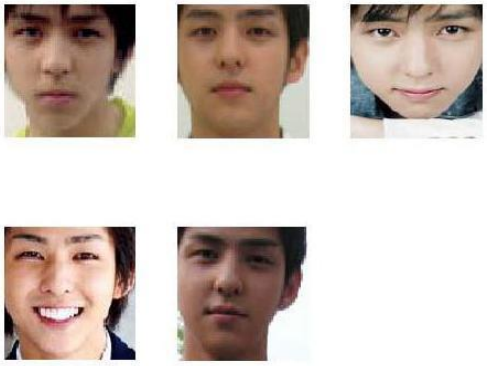

Figure 8 Normalized training sample faces

Figure 9 Normalized unrecognized images

B. Feature Extraction of faces images

After pretreatment, the dimensions of faces' images are still very high and it leads to complex calculation as well as difficulty of classification. Therefore, feature extraction is an inevitable step, in order to reduce the dimensionality of targets. After feature extraction, input data will become to a reduced representation set of feature which is named features vector.

In this paper, we use wavelet transform to get feature extraction. Apply 2D discrete wavelet transform on images to decompose 2D images in different sizes and get approximate components of images cA, horizontal detail components cH, vertical detail components cV and diagonal detail components cD. And approximate components of images cA are generally low-frequency components which contain the main features of images. All components cA, components cH, components cV and components cD can be treated as the feature information. However, in this paper we treat approximate components cA as feature information of images to reduce computation.
But, due to wavelet transform just process value, color index images must be coded, and then wavelet transform is meaningful.

To reduce the computation of compare, this paper uses wavelet decomposition on the same person's images in 5 layers, and compares each outcome.

C. Feature matching of face recognition

In the process of facial recognition, facial matching is a significant step. Currently, researchers mainly utilize gray cross-correlation matching on edge points or points. To get excellent outcome of recognition, this paper selects points matching which combines wavelet transform and threshold compare. In the process of feature matching, it is clearly inevitable to define corresponding reference image's difference between unrecognized images and training samples. In addition, define different thresholds of comparison approximates and details. Though images matching of points feature have very high validity and reliability, it also must be noticed that if unrecognized images and training sample images have very large differences, points feature will be hard to be realized.

D. Result of faces recognition

This paper uses m files which compiled before to get recognition outcome which judge whether the images are for the same face. And this paper uses brief and clear output.

V. CONCLUSION

We are mainly designed to use wavelet transform to realize facial recognition. The outcome proves that m files can correctly identify faces images. It means that when wavelet transform has its own particular advantage in feature extraction and image recognition. For example, reduce computation of feature extraction, match approximate components, vertical detail components, horizontal detail components and diagonal detail components, and meanwhile, get different recognition effect by corresponding wavelet transform in different layers. To sum up, wavelet analysis is a practical method to realize face

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